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THE LESSON OF HEREDITY.

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THE scientific shibboleth of our time is heredity. The word is on everyone's tongue. Viewing a fallen fellow-mortal, it is quite the fashion to shake one's head and say, "Oh, heredity accounts for him ; blood will tell." And with this formula we are accustomed to measure our fellows, much as a clerk measures cloth. And lest there should be any doubt about the method, the man of science comes to our aid. "Yes," he says, "you are quite right. Your formula expresses the universal principle of heredity. We word it a little differently, but the idea is the same. 'Like begets like' is the way we put it. It applies to every living thing in the world. Notice this bacillus, for example. Even as you observe it beneath the microscope, it divides, and two baccilli are there in place of one. This process it will continue indefinitely, under proper conditions, until there are myriads of bacilli there, but every one will be precisely like the first. The cholera bacillus never changes into the bacillus of consumption, nor that into the bacillus of diphtheria. Each produces its own kind and no other. 'Like begets like !' It is beautifully simple, unequivocally true, and of universal application."

It is little wonder that so relatively simple, so true and so sweeping a proposition has proved alluring. All universal formulæ are so. But it should not be forgotten that a seemingly simple principle may become very complex indeed, in its application. So it is here. Indeed, a stumbling-block of most alarming dimensions appears at the very outset if we attempt to apply the principle of heredity intelligently to any higher organism, in the fact

that two parents are to be considered. These parents are not precisely like one another, hence, in the nature of the case, the offspring must be either identical with one parent and unlike the other, or else identical with neither. Here theory wavers, but experience proves that the offspring always combines in some measure the qualities of both parents; hence, that it never is precisely like either of them. What, then, becomes of the principle of heredity? It appears that like does *not* beget like in the sense of identity; and if "like" is only meant to convey a sense of general similarity, it is altogether too vague a principle to have practical utility.

In point of fact, however, no such vagueness exists. The seeming obscurity results partly from the complexity of the conditions and partly from misapprehension of terms. The explanation is found in the fact that heredity implies not so much the transmission of conditions as of tendencies. Speaking loosely, we often say that consumption, insanity, and heart disease are hereditary. Strictly speaking, the statement is never true. An inherent weakness or susceptibility of lungs, brain, or heart—a tendency towards disease of these organs—may be transmitted, but not the diseases themselves. And so of other conditions. The word tendencies is our open sesame. Two parents having qualities unlike and often mutually exclusive cannot transmit these qualities to their common offspring; but they can transmit all their tendencies to that offspring, even though these tendencies be antagonistic. An organism cannot *be* two things at once, but it may *tend* to be many different things; antagonistic tendencies within it constantly struggling for the mastery. And aided by external conditions, the tendencies at one time subordinate may at another time become dominant. Failing of such favorable conditions, tendencies may keep up an unequal and seemingly inefficient struggle throughout the lifetime of an individual, without once making themselves manifest, and yet be transmitted to the offspring with such potential force as there to become operative.

To tangibly illustrate: If one parent has black eyes, the other blue, it is evident that both cannot transmit the color of the eyes to their child. But one may transmit a tendency to black eyes, the other a tendency to blue, and according as one tendency or the other proves the stronger, the child will have black or blue

eyes. Suppose the black-eye tendency prevails for the moment—that is, for that individual. The blue-eye tendency is not eliminated; though dormant for that generation, it may reassert itself so strongly that a child of the next generation will have blue eyes though both its parents have black eyes.

Nor is this all. A tendency may remain dormant, and perhaps unsuspected, not merely for one but sometimes for many generations, becoming at last manifest again in a remote descendant. And this is as true of mental and moral tendencies as of physical. In short, the observed facts would seem to warrant the conclusion that the organism never relinquishes any tendency it has once acquired, but holds it in stock, if need be, generation after generation, awaiting a favorable opportunity to herald it forth. Only by such a supposition can we explain the commonly-observed fact of inheritance from remote ancestors, or, as Darwin termed it, atavism.

Manifestly, then, we shall greatly err if we attempt sweeping estimates of a child's hereditary tendencies from a study of its parents alone. Nor will it suffice to turn to grandparents, or even great-grandparents. Atavism assuredly reaches far back of these. But if we invoke a remoter ancestry, we shall be dumb-founded at the response. Behold them! There were eight great-grandparents; thirty-two individuals in the generation before that; then 64, 128, 256. We have reached back only to the time of the Pilgrim fathers. And still they accumulate, these unavoidable ancestors. In the tenth generation they number a thousand, omitting an unimportant dozen or two for the sake of round numbers; in the twentieth generation they are an army of a million. And this is going back only to the twelfth or thirteenth century. One need go but little further and the seemingly unassailable mathematical will name him an ancestry co-extensive with the entire population of the globe. Thus are we all proven brothers in fact as well as name. Thus is the antiquarian justified who had traced his ancestry down to the beginning of the seventeenth century, but there lost it; in truth he can scarcely have gone amiss up to that time. Seventeenth, eighteenth and nineteenth century genealogies are for parvenus.

But behind the jest lie sober realities of the most far-reaching import. Admitting that when examined critically our computation is somewhat shorn of its astounding proportions by mar-

riages of consanguinity, the fact remains, beyond all levity, that every human being, high or low, has had within recent times a multitude of ancestors in direct line of descent. Marriages of consanguinity being, perhaps, most frequent in circles of royalty, probably the persons who have the fewest ancestors, and of whom, therefore, as we shall see presently, we should expect the least, are kings and their kith. And yet the aristocrat is wont to look down upon the plebeian because he has no ancestors ! He means, of course, that the plebeian does not know the name of his ancestors. But what does he know of his own ? Sir John Jones boasts loudly of his lineage because he knows the names of his little line of Jones ancestors for, say, ten generations back. He holds in contempt poor Smith who cannot bring documentary evidence that he had a great-great-grandfather. But has Jones at his tongue's end the records of all of the other fifteen of his own ancestors of that fourth generation whose names were *not* Jones ? I venture not. But even if he had, what does he know of that boasted tenth generation ? Why, that *one* member was named Jones. But what of the 1,023 other individuals who make up the remainder of the phalanx ? The ancient Jones may have been a very great man indeed, but he represents less than one-tenth of one per cent. of the present Sir John's ancestors of that single tenth generation. Fortunate is it for Sir John's peace of mind that he does not know the others, for it is many chances to one they were a motley crew, scattered in all parts of the globe. Not improbably, there were a few Turks and Arabs, and a Negro or two in the company, and it is not at all unlikely that a few score of them were vassals or slaves to some of poor Smith's illustrious but now forgotten ancestors of that same generation.

But whether kings or vassals matters not for our purpose. It is only important to recall that these multitudinous ancestors existed. And there they surely are, ready to be summoned at a moment's notice by the simplest computation. Making fullest concessions to consanguineous marriages—say by reducing the number one-half—there still remain more than one thousand shades to answer the roll-call of each and every individual's ancestors within ten generations past. And the principle of atavism is at hand to prove that any particular tendency of any one of these ancestors may crop out unexpectedly after being long suppressed ; nay, more,

that all the multitudinous tendencies of all these ancestors must be represented—though combined and modified—in the personality of each Smith and Jones, and X, Y or Z of to-day. An awful thought, is it not? What wonder that we poor conglomerate mortals are torn by doubts and uncertainties, and contradictory aspirations and conflicting passions? What wonder that consistency is rarest of jewels? The wonder is rather that we can manage to spin any continuous or rational thread of life at all out of such a tangle of unmiscible tendencies. “Like begets like” has ceased to be the simple principle that it seemed.

It appears, then, to use a graphic illustration, that every individual represents the apex of an inverted pyramid of descent, whose base, extending back into history, at some point coincides with the base or a sectional plane of the ancestral pyramid of every other individual of his race. Why, then, since the same principle has applied to all, are not the apices all identical? How has the principle “like begets like,” applied to a common ancestry, produced such a diversity of descendants? Heredity, unaided, can give but one answer to this question. It is because the elements of this conglomerate ancestry have not been mixed equally. In other words, because of marriages in different degrees of consanguinity. The answer is not sufficient, yet it can account for much. Let us examine it before seeking for other causes.

In the nature of the case, if men are all descended from a common stock, all marriages must be in some degree of consanguinity. But the degree may vary from the incestuous union of brother and sister, which was legalized among the ancients, or the marriage of cousins, which is the limit fixed by most modern civilizations, to the usual cases in which all trace of relationship has long since been lost. At first sight, it is perhaps not apparent why marriages in close degrees of consanguinity should be of especial significance in their bearing on the problems of heredity. But a moment's reflection will make this plain. In the first place, a consanguineous union greatly restricts the variety of tendencies of the descendants. A person whose parents are cousins, for example, has only six great-grandparents, instead of the normal number of eight; and thus, to carry the computation no farther than that generation, his aggregate tendencies are restricted in diversity by one-fourth—in itself a serious matter.

And, in the second place, certain of these restricted tendencies may be accentuated in a way that may be yet more serious. These are tendencies of the two great-grandparents in whom both lines of descent meet, and who therefore count as four persons in reckoning the child's inherited possibilities. The offspring of cousins may therefore be theoretically expected to have (1) less than the average diversity of tendencies, and (2) an abnormal instability of tendencies, due to the accentuation of certain groups. And here practical observation fully sustains theory. It is by the application of these principles that all the specialized races of domestic animals have been so rapidly developed.

This, then, I say, is the only answer which heredity alone can give as to why individuals vary in their tendencies and qualities. The answer does not seem sufficient, for to be tangible it is evident that the unions must be in close consanguinity, and it is well known that such unions are everywhere exceptional. Even barbarians go to outside families, and even to outside tribes for wives. But aside from this objection the argument contains a fallacy in that an element not accounted for by heredity alone has been introduced unwittingly. And in some respects the interpolation is of more importance than the original document. Let us look more critically. We have just assumed that every individual inherits all the tendencies of all his ancestors. If, then, all the tendencies of the race were represented in that remote common ancestry to which we are referring, and all these tendencies again were epitomized in each and every descendant, it is not apparent why it should make much difference whether a being has six great-grandparents or eight, since the two ancestors who would be doubly represented in the curtailed generation would doubly represent exactly the same focalized group of tendencies as would be represented by any other two persons. And yet we know that consanguineous unions do make a difference in practice. We have come to another stumbling block. But the explanation is not far to seek, though it lies partly outside the domain of heredity. We have said that every individual comes into the world with possibilities representing the sum of all the tendencies of all its ancestors. This formula is certainly at once correct and comprehensive. It would be a misuse of language to speak of inheritance of a tendency not represented in some ances-

tor, near or remote. But the same formula does not represent fully the personality of the same individual when he has grown to adult life, for then we must say, The sum of all the tendencies of all ancestors *plus* certain qualities developed in the present generation through contact with a definite environment. And these acquired qualities we are bound to believe, notwithstanding the dissent of a certain school of modern biologists, are represented in the sum of tendencies which this individual transmits to his progeny. It is as if an ancestral estate received additions with each generation of holders. Only it must be remembered that the additions are not necessarily improvements. There are minus as well as plus quantities in our problem of heredity.

Not only may new tendencies be thus added generation after generation, but the old tendencies may be given new significance, certain ones being developed under a fostering environment till they preponderate as they had never done in a previous generation; other tendencies being, of course, proportionately pushed into the background. Manifestly, then, this new factor of environment is a force to be reckoned with. It is the variable quantity which is introduced into the personal equation of every creature, to be considered along with the fixed quantity, hereditary tendencies. And as this variable can never be exactly the same for any two organisms in the world, it follows that no two personalities can ever be identical. Thus it appears that the diversity of individuals and of races, which is the observed condition of organic nature, has come to pass primarily through environment, not heredity. Now it is manifest why it does make a difference whether one has six or eight ancestors of the third generation, for the two additional ancestors would have brought certain tendencies that had been developed by the specific environment of their particular lines of recent ancestors, which must necessarily have varied somewhat from the tendencies of each of the other ancestors of that or any other generation. The remote or fundamental tendencies, inherited from the common ancestry far removed, would have been the same in all; the points of difference pertain to certain less fundamental, but scarcely less important, lines of special development.

And these additional tendencies, as we have seen, are not to be set down to the credit of heredity, but to that of environment. And, indeed, if we were to carry the analysis back along exactly

the same lines to include the remote ancestors and their fundamental tendencies, we should find that exactly the same arguments apply there with equal force. Time was, in the far past, when these qualities, which we now term fundamental because they are of long standing, were in their turn developing; and we are bound to believe that they also were developed primarily through the influence of environmental forces, acting on a responsive organism. In fact, all that we can know of life and mind is the reaction of a certain kind of matter to the impinging forces of its environment. In this view, the most that can be said for heredity is that it has held a kind of receptacle into which tendencies as they were developed were thrown for safe keeping. It has developed nothing, originated nothing; but it has been a most faithful Lord High Keeper of the Treasury, for it has let no single precious tendency escape when once it had been acquired.

The function of heredity, then, is the retention and transmission of tendencies. This function it performs with the most absolute impartiality. It sees to it that each quality of an individual—whether dominant or subordinate, patent or latent—is represented in the progeny of that individual. It can do no more; its mission is completed for that generation; it must leave the plastic material for the great moulder, environment. And the forces of environment come to the attack right vigorously. But they also have their limitations. Certain general characteristics of body and mind have been so ingrained in the race through persistent repetition that they can by no possibility be greatly altered in a single generation. All the tendencies of all the ancestors near and remote coincide in the direction of these qualities. The transforming power of environment must turn chiefly to those newer tendencies which have been developed in recent generations, and to a decision between antagonistic tendencies. And yet even the primordial tendencies are not altogether beyond the pale of environment, because none of them are absolutely fixed by heredity. Take the matter of stature, for example. The ancestral tendencies vary within a limit of many inches. Some ancestors have been perhaps but four feet tall, others have been nearer seven feet. But there is a strong average tendency perhaps towards a stature of between five and one half and six feet. Within these limits, environment may under ordinary circumstances decide. Nutritional conditions during infancy, childhood,

and adolescence—the presence or absence of disease at critical periods, and the like—will determine the exact stature in the individual case, just as general nutritional conditions have determined the average stature of different races of men—the Esquimaux, for example, or the Patagonians.

And what is true of the physical stature is equally true, *mutatis mutandis*, of the mental and moral stature. But the fact that the stature, physical, mental and moral is fixed at a certain limit for one individual, does not irrevocably fix the limit for the offspring of that individual. Each individual case changes the average of tendencies, of course, but it does not eliminate the old tendencies; and these old tendencies, reacting to a changed environment, may produce a very different individual result in a succeeding generation. The average results, in deviation from the old average, only assume permanence when the race is subjected generation after generation to the conditions that first wrought an individual change. The Esquimaux, for example, have come to be a race of relative dwarfs because their environment has for generations been defective from a nutritional standpoint. But no doubt atavism still holds for them the tendency of remote ancestors to larger stature, and under changed meteorological conditions they would doubtless return gradually to the old-time average. But even under conditions as they exist, environment has not changed the physical, mental or moral qualities of this race in *kind*, but only in degree. The broad synoptical outline of qualities inherited from the remote common ancestry are still the same as those of every other race of human beings in the world. It is the specific, the newer, and hence, on the whole, the less essential qualities that differ.

If this is true of different races of men, it must be far more tangibly true of the extremes of the same race, who live under conditions much less widely variable than those that separate the races. Caucasian and Esquimaux must perhaps go back millennia to find a common ancestor; but the lord of the manor and his lowliest servant have probably had common ancestors within a few centuries past. Not merely their fundamental tendencies then, but many of the more specialized tendencies are inherently the same in both. The familiar traditional tales, doubtless some of them founded on fact, of infants of beggars and princes being transposed in the cradle without subsequent discovery,

illustrate this fact perhaps as forcibly as a more sober argument could do.

If further proof were needed, one has but to turn to the records of common every-day experience, and analyze the characteristics of such representatives of the extremes of contemporary society as are personally known to him. He will find the same general physical qualities, the same general mental qualities, above all the same general moral qualities at each end of the social scale. Why? Because these general qualities have had the stamp of approval of myriads of common ancestors. The details of specialization differ widely, of course; as widely in mental and moral directions, as, for example, the unkempt beard and ragged clothes of the one differ from the waxed moustache and fashionable suit of the other. Such differences have been wrought by different recent environing conditions, but far more significant likenesses have been retained. The lovers of Mary Ann settle their rival claims by resort to fisticuffs; the lovers of Priscilla by innuendo, or repartee, but the principle is the same. The hero of the Bowery stage overcomes the villain perhaps by blows, at least by physical prowess; the Broadway hero triumphs through more subtle and intellectual processes. But the essential thing is that in each case the hero must triumph. He may swagger with hands in pockets, or perhaps boast and swear in choicest Bowery dialect; his pathos may be, for more refined ears, suspiciously like bathos; his courage may be bravado; but always, in the intellectual eye of his audience, he must be an approach to an ideal hero, good, noble, aspiring, or he cannot receive the plaudits of even the worst audience. Why? Because we look to stage and story for ideals, and the same ideal aspirations have been inherited from remote common ancestors by both extremes of our social life.

The fact, then, is everywhere patent that heredity accounts for the sameness of our race, not for the differences. The latter are the work of environment. It is further true that it is the plan of Nature—to use for convenience sake, the old language of teleology—to avoid extremes and keep as near as may be to the happy mean through the aid of heredity. It is as if she looked with equal affection upon every tendency once implanted in a race of her creatures, and strove always to aid the tendencies that were for the moment subordinated. To accomplish this end she adopts a very simple but very effectual expedient. We ex-

press this expedient commonly in the saying that opposites attract. This means, in the light of what we have just seen, that a person is drawn towards a person of the opposite sex whose predominating tendencies correspond to his subordinated ones. By this means tendencies subordinated in one generation are reinforced and become dominant in the next ; by this means, in other words, atavism is accomplished. Note, as practical illustrations, how tall men are attracted by small women, blondes by brunettes, genius by mediocrity. It is even matter of common experience that the most virtuous young women are often fascinated by the opposite moral traits in their male associates, while, contrariwise, the most vicious of men would always choose virtuous helpmates if they could. Thus, within the ranks of any caste of society, there is a constant effort to equalize the average tendencies and bring back that hereditary balance which environment is forever tending to disturb.

A like effort in a wider way is manifest in balancing the castes themselves. For every specialized development far in one direction, brought about through a pampering environment aided by consanguineous marriages or marriages of expediency, carries its own Nemesis, in the fact that growing instability always goes hand in hand with extreme development. We noted how specialized races of domestic animals have been rapidly developed by special environment and artificial selection (corresponding to marriages of expediency), and now we have further to note that the specialized race so developed is always an unstable race as compared with the mother stock from which it has sprung. Only by a perpetually pampering environment and a selective in breeding of an unnatural kind can it be kept from reverting through atavism to the original type ; and if it is allowed to return to natural environmental conditions, it immediately does begin to return to the old-time average status—as witness the wild horse. All this, of course, is explained easily through the struggle for existence and its resulting natural selection. Now exactly the same thing occurs among human families under similar conditions. The best illustration is afforded by the uniform history of royal dynasties. Founded usually by some person who combined rare and desirable hereditary tendencies, they are perpetuated by tradition, under an enervating environment, to whose undermining influences are added the like influences of marriages of expediency and often of

consanguinity, until in a few generations the inevitable result is reached of ill-balanced offspring, often brilliant in certain useless directions, as often insane, who are unfitted to rule, and who are presently supplanted, despite tradition, by some strong offshoot of the family, or some entire outsider, whose descendants will in turn reënact the same cycle of degeneration.

In a lesser degree, this same cycle is to be witnessed in the family histories of those upper strata of society that are always prone to model after royalty. The degeneration and frequent extinction of our "oldest and best families," with the concomitant rise of new families, is an illustration within the experience of everyone. But everywhere it is the same story: through environment, primarily, are the changes wrought: through heredity—especially as exemplified in atavism—is the stability of the race maintained. These two forces are respectively the Radicals and the Conservatives of Nature. The one insures progress, the other prevents evolution from taking such strides as would lead the race to disaster.

In one sense, perhaps, we are all "born criminals," for we inherit from remote ancestors traits that if they had free play would ill accord with the customs of our modern civilization. The child who, in a moment of impotent anger, claws viciously at the face of its mother manifests an emotion no different from that with which the remote feudal ancestor fell upon his enemy and gave him battle. The proverbial cruelty of children to animals is perhaps reminiscent of those days when the ancestors of the race lived by the chase. But these are single phases of a most complex personality. The same infant that at one moment is so vicious will the next moment hold up for the kiss of the mother cheeks wet with penitent tears. The boy who feels an instinctive desire to hurl stones at a strange dog, will just as instinctively bestow upon the same dog acts inspired by regret and pity if his missile unfortunately find its mark. The two sets of emotions are antagonistic, but they are alike "instinctive." One needs but watch for an hour the conduct of a child yet so young that his deeds express instead of masking his emotions, to gain tangible evidence of that complex host of antagonistic tendencies that are battling within the budding mind. And when one realizes at its full value the fact that no one of these tendencies can, by any possibility, be altogether blotted out from the personality of that being while it lives,

he will realize, also, that such flippant phrases as "altogether good," "wholly bad" and the like have no real meaning as applied to the complex mind of man. It may be conceded, of course, that if we were to classify all human tendencies by an ethical standard into two groups, every mortal must, at a given moment, strike a balance for good or evil, though most of us, I fear, would be very close to the line at best. But in the light of heredity—of atavism—it can never be conceded that any mortal has been or can be born into the world who has not inherent tendencies that are good as well as those that are bad. From which follow the warning corollary that no mortal can be above the possibility of temptation, and the cheering one that none can be beyond the pale of hope. And this is, to me, the great lesson of heredity.

He has but poorly read the lesson who will attempt to definitely forecast the future of any human being. Only a false prophet could, in the name of heredity, deny all hope to the child even of the most depraved criminals. As it lies there in its cradle even amidst the squalor of poverty and vice, no one can deny that it is a sweet and innocent morsel of humanity; and if contemplation of its parents causes us to shudder for its future, we may obtain a vision equally valid and far more cheering by letting our mental retrospect extend to include the worthier members of a conglomerate ancestry. Of a certainty there are good tendencies as well as bad welling up into that nascent mind. Not improbably there are many evil currents sweeping in one direction nearest the surface, but rest assured there are deeper counter currents. Whether these deeper currents will ever reach the surface is a question that lies without the pale of heredity. That delightfully impartial verdict "Blood will tell" conveyed all the message that heredity could bring. But *which* blood—the good or the bad? Heredity cannot answer. The decision rests with environment. Hence the fundamental mission of all social reforms that go to the heart of things must be to so mould the average environment of civilization that in a larger and yet larger percentage of cases the good blood rather than the bad in each newest generation shall be *made to "tell."*

HENRY SMITH WILLIAMS.